

REMARKS/ARGUMENTS

In the Office Action dated January 15, 2004, the Examiner has rejected Claims 8 under 35 U.S.C. §102(e), and rejected Claims 1-3, 5, and 7 under 35 U.S.C. §103(a). The Examiner has kindly indicated that Claims 4, 6, and 9 would be allowable if rewritten in independent form, including all the limitations of the base claim and any intervening claims. By this paper, Claims 3 and 5 have been amended to more distinctly indicate that which Applicants regard as the invention, and Claims 4 and 9 have been rewritten in independent form (Claim 6 has been cancelled). Further, new sheets of drawings have been submitted to replace those corresponding drawing sheets originally submitted with this Application. For the reasons set forth below, Claims 1-5 and 7-9, as amended, the claims remaining in this Application, are now considered to be allowable.

Applicants' invention is directed to an edge enhancement processing system and method for modifying image data at certain pixel locations to include gray scale image data so as to reduce jaggedness in the image. An adjustable threshold device establishes a binary pixel value for an incoming current gray level pixel in accordance with a thresholding criterion. An operator accessible input to the thresholding device is used by the operator to adjust the threshold value in the thresholding criterion. A current binary pixel formed in accordance with the thresholding criterion and neighboring pixels also so formed in accordance with the thresholding criterion are examined in accordance with predetermined criteria for determining adjustment of the current pixel to a gray scale value to reduce edge jaggedness of the image. Generally, adjustment of the thresholding value is made in instances where under color removal and/or gray component replacement is employed. Such processing system is not shown or in any way taught in the prior art.

Claims 8 stands rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent 6,088,130 (Matsukubo, et al). The Matsukubo, et al. patent discloses an edge enhancement method for processing image data using under color removal and/or gray component replacement, and adjusting edge enhancement processing of the image data in according with whether or not under color removal and/or gray component replacement is used or the extent of such use. However, the Matsukubo, et al. patent shows the under color removal output and the filter output are two

separate and distinct outputs, and the coefficients of spatial filters are changed with regard to a character edge, character interior and screened dot/half-tone image. Coefficients are changed in dependence upon thickness with regard to character edges as well (note column 10, lines 35-39 of the reference). Accordingly, the filter coefficient that directs which spatial filter to use for edge enhancement, does not show dependency on the under color removal, but rather on image structure information. Furthermore, the Matsukubo, et al. patent discloses that with regard to color characters, all are subjected to possessing identical with that for black characters with the exception of the masking under color removal coefficients (note column 10, lines 41-43 of the reference). Therefore, the under color removal coefficient is directing the masking under color removal unit as to the amount of under color removal performed on the CMY input data, but is not affecting the filter function for edge enhancement. Thus, the Matsukubo, et al. patent does not in any way anticipate processing image data using under color removal and/or gray component replacement; and adjusting edge enhancement processing of the image data in accordance with whether or not under color removal and/or gray component replacement is used or the extent of such use, as specifically recited in Claim 8. The edge enhancement anti-aliasing methodology used in Applicants' invention described in this Application (see Figure 12 in the Application) is far more sophisticated so as to handle threshold modified image data (such as processing after UCR/GCR) than that of simple smoothing and sharpening filters (filtering functions) shown by Matsukubo, et al. These are important aspects of Applicants' invention. Therefore, it is respectfully submitted that this rejection is improper, and independent Claim 8 should now be allowed.

Claims 1 and 2 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,920,646 (Kamon) in view of U.S. Patent 5,703,971 (Asimopoulos, et al.). Regarding Claim 1, Kamon teaches an edge enhancement processing system for modifying image data at certain pixel locations after binarization of the gray scale image data (19, 100 and 101 of Kamon Figure 2 and 3). The edge enhancement anti-aliasing image processing device disclosed by the applicants (see Figure 1 and 12 of current application as well as prior U.S. Patents 5,502,793 and 5,600,761 by the same Inventor for comparison) is quite different than

the edge enhancement processing system teaches by Kamon. Also, the Examiner has correctly pointed out that Kamon does not teach an adjustable threshold device with an operator accessible input to the threshold device for adjusting a threshold value in the threshold criteria as taught in applicant's independent Claim 1. Asimopoulos, et al. teaches a method and device to perform automatic optimization of black and white imaged created by a scanner. The device performs dynamic thresholding by approximating the information level and the background level at every pixel in the image, the threshold being calculated as a function of the background and information levels at that point, and a characterization process step comparing the pixel intensity at that point with the threshold, so an optimized binarized output is the result. Since the dynamic threshold is a function of both the background level and the information level and the threshold is changing dynamically from pixel to pixel, it is not an operator accessible input to the threshold device for adjusting a threshold value in the thresholding criterion as stated in applicant's Claim 1. Further more, the setting of the dynamic threshold value in Asimopoulos, et al. requires both the information level and background level of the image (Asimopoulos, column 3, lines 50-57), it is different than the way that the threshold value is selected here in the application (for example in later claims 3 and 7 when UCR/GCR are used – no background level information is required). Asimopoulos, et al. also did not teach anti-aliasing edge enhancement method or output data other than binary data. Accordingly, Applicant's invention would not be obvious to one of ordinary skill in the art in view of the cited references either individually or in any proper combination. Therefore, independent Claim 1, should now be allowed.

Regarding Claim 2, the Examiner has correctly pointed out that Kamon does not teach a step of determining an adjustable threshold value in a holding criterion in response to an input from an operator. With respect to Asimopoulos, et al., since the dynamic threshold is a function of both the background level and the information level, and the threshold is changing dynamically from pixel to pixel, it is not set by determining an adjustable threshold value in a thresholding criterion in response to an input from an operator as recited in Applicants' Claim 2. Furthermore, the setting of the dynamic threshold value in Asimopoulos et al. requires both the information level and background level of the image, witch is different than the way

that the threshold value is selected here in the instant Application. Asimopoulos, et al. also do not teach anti-aliasing edge enhancement method or output data other than binary data. Accordingly, Applicants' invention would not be obvious to one of ordinary skill in the art in view of the cited references either individually or in any proper combination. Therefore, independent Claim 2, should also now be allowed.

Dependent Claims 3, 5 and 7 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,920,646 (Kamon) in view of U.S. Patent 5,703,971 (Asimopoulos, et al.) as applied to Claims 1 and 2, respectively, and further in view of U.S. Patent 5,974,171 (Hayashi, et al.). The Examiner points out that the combined teachings of Kamon and Asimopoulos, et al. are not directed to color separation image data that has been subjected to under color removal and/or gray component replacement (Claim 3) or a color transformation process (Claim 5) before being transformed into a binary pixel. Hayashi, et al. teaches an edge enhancement method conducting edge enhancement or smoothing (see column 9, lines 21-22 of the reference) which operates on color separation image data that has been subjected to under color removal and/or gray component replacement and a color transformation process, also before being transformed into a binary pixel. In addition to the above arguments relative to Applicants' invention, as recited in Claims 1 and 2, being unobvious to one of ordinary skill in the art over the cited references to Kamon and Asimopoulos, et al., dependent Claim 3 and dependent claim 5 positively recite transforming image data via the adjustable threshold into binary data first before the edge enhancement anti-aliasing method. It should clearly be recognized that binary conversion prior to enhancement, according to Applicants' invention as claimed, is less complicated and provides better enhancing than filtering. Accordingly, Applicant's invention would not be obvious to one of ordinary skill in the art in view of the cited references either individually or in any proper combination. Therefore, amended dependent Claims 3 and 5, should now also be allowed.

Relative to dependent Claim 7, the Examiner stated that Asimopoulos, et al., as mentioned above regarding Claims 1 and 2, teach an adjustable threshold value which is determined in accordance with a selection by the operator, and Hayashi, et al., as mentioned above regarding Claims 3 and 5, teach color image processing that includes under color removal and/or gray component replacement. As

U.S. Application No. 09/628,397 – Filed: August 1, 2000
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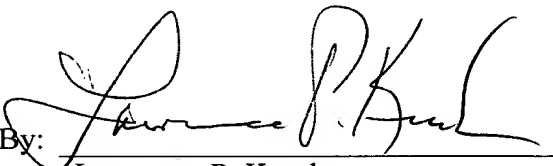
Applicants have distinctly pointed out above, the adjustable threshold value in Asimopoulos, et al. require both the information level and background level of the image (see Asimopoulos, et al., column 3, lines 50-57), which is different than the way that the threshold value is selected here in the instant Application. Accordingly, Applicants' invention would not be obvious to one of ordinary skill in the art in view of the cited references either individually or in any proper combination. Therefore, dependent Claim 7, should now also be allowed.

Claims 4 and 9 have been amended so as to be presented in independent form as suggested by the Examiner. Accordingly, Claims 4 and 9, as amended, should now be allowed.

Applicants are not aware of any additional patents, publications, or other information not previously submitted to the Patent and Trademark Office which would be required under 37 C.F.R. §1.99.

This Application is now believed to be in condition for favorable reconsideration and early allowance, and such actions are respectfully requested.

Respectfully submitted,

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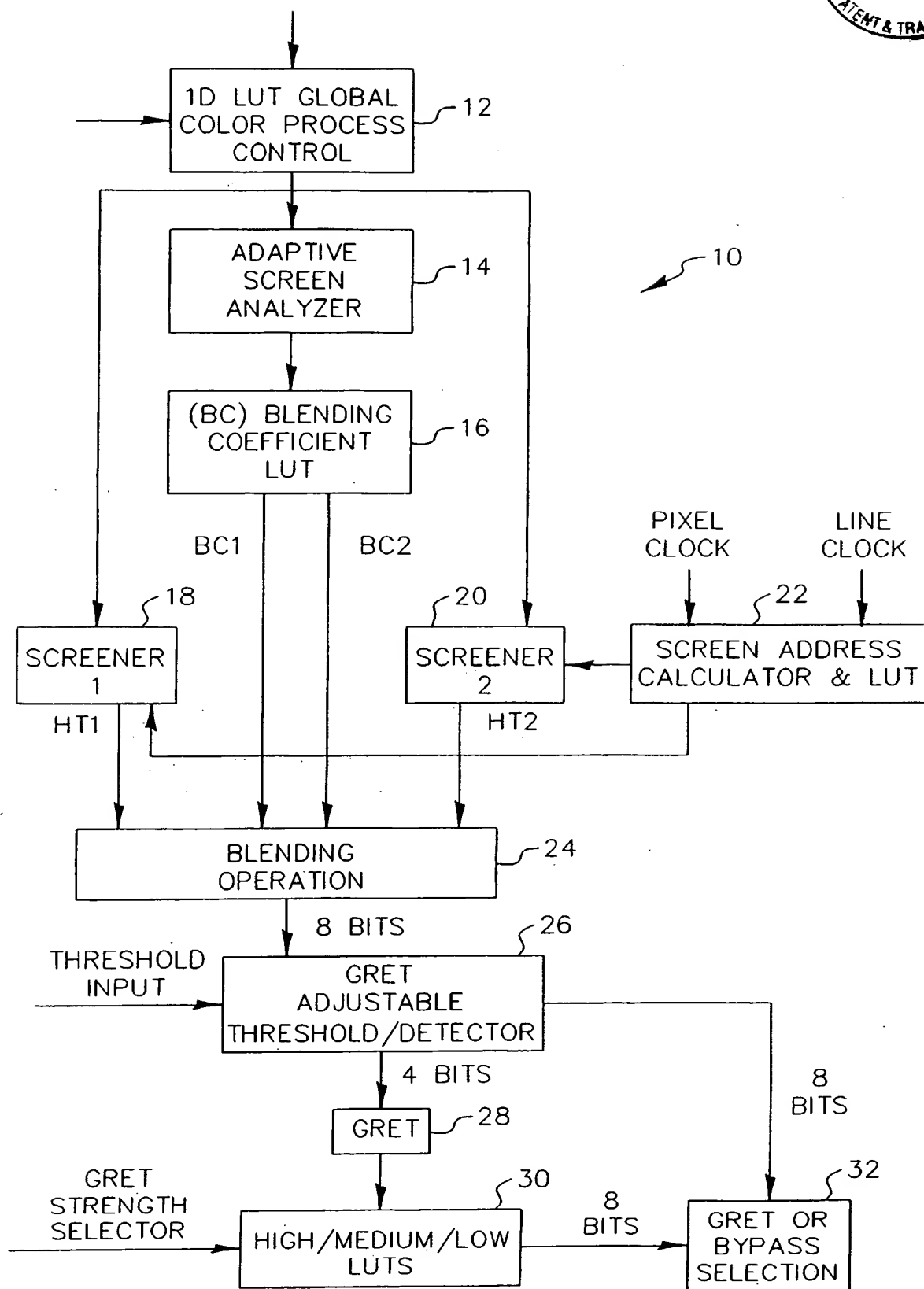
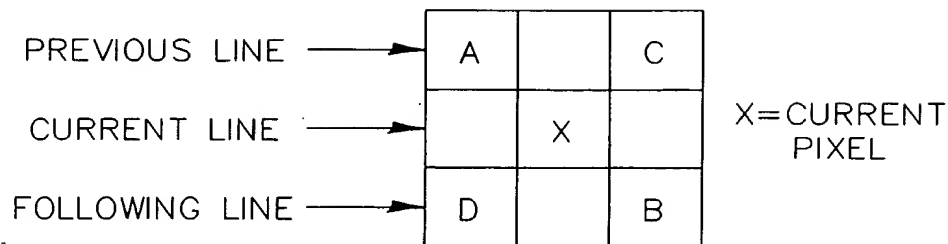


FIG. 1



$$\text{CONTRAST INDEX} = \text{MAX} (|A-B|, |C-D|)$$

FIG. 2

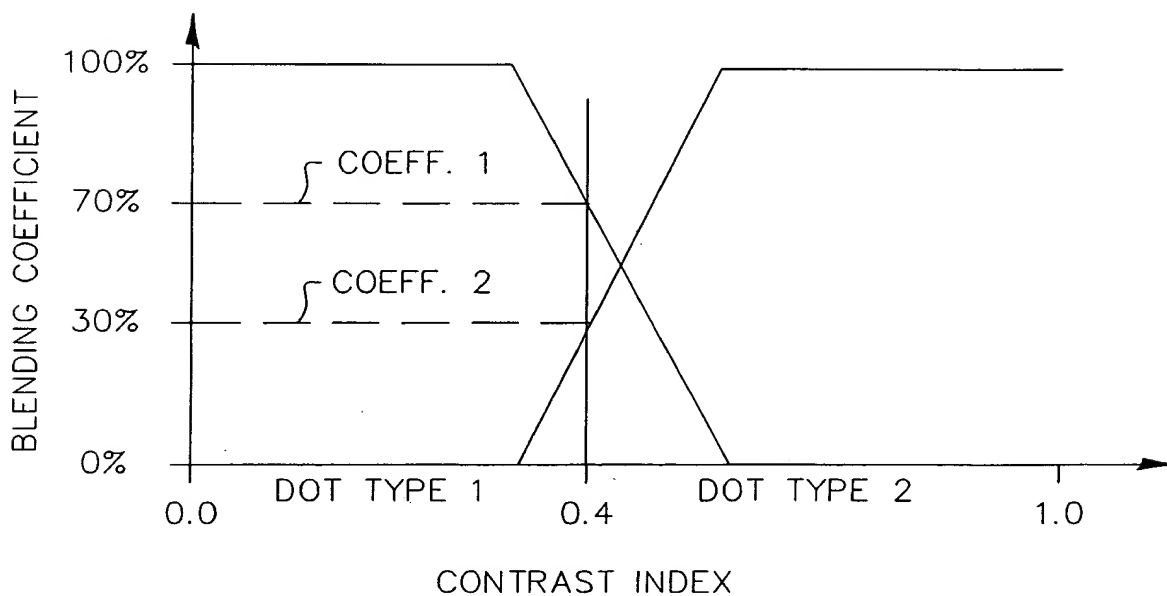


FIG. 3

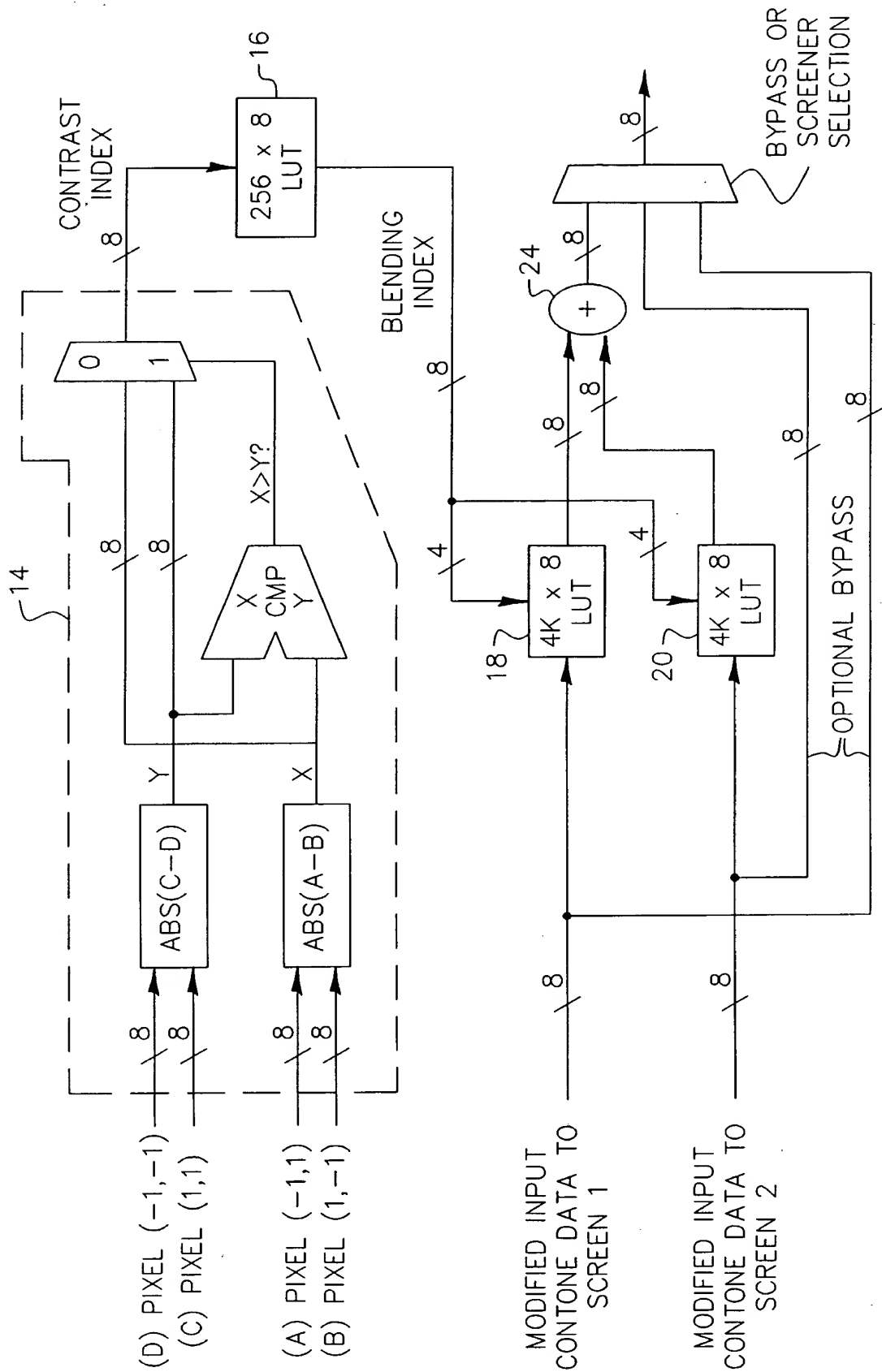


FIG. 4

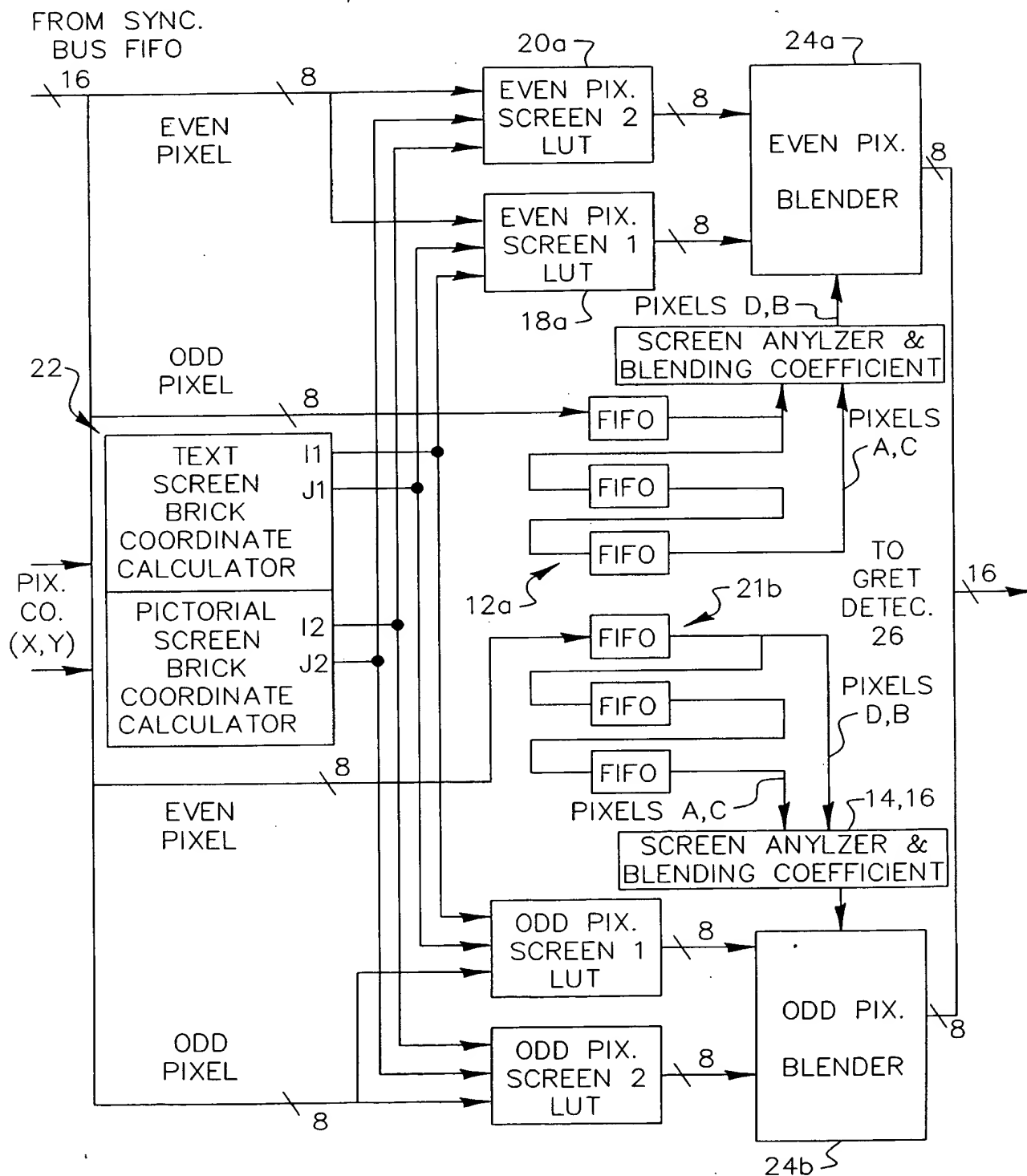
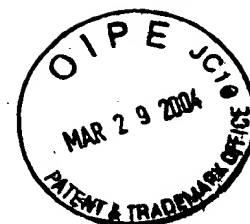


FIG. 5

[illegible]

FIG. 6a

[illegible]

FIG. 6b

[illegible]

FIG. 6C

[illegible]

FIG. 7a

[illegible]

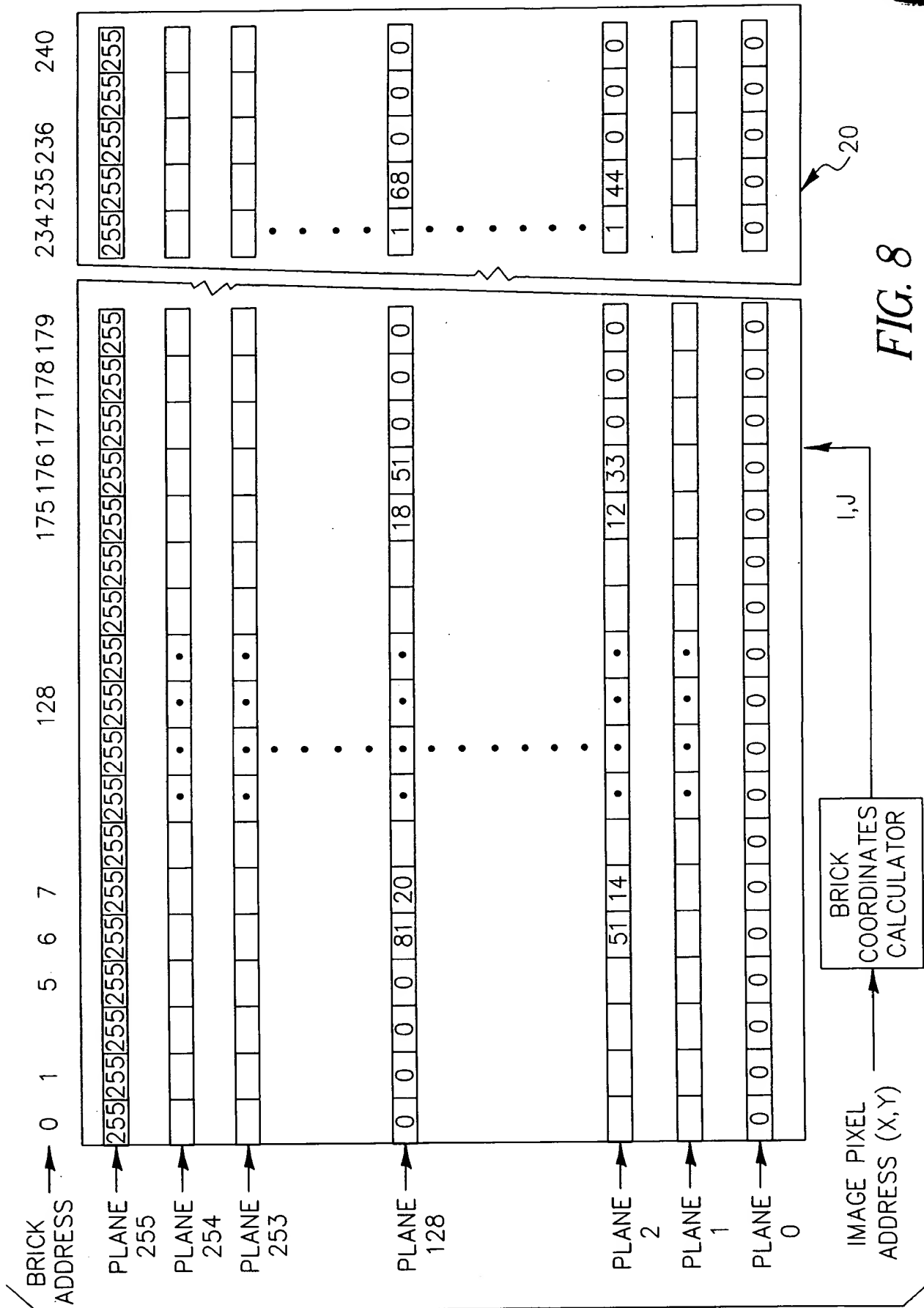
FIG. 7b



PLANE=2

[illegible]

FIG. 7C



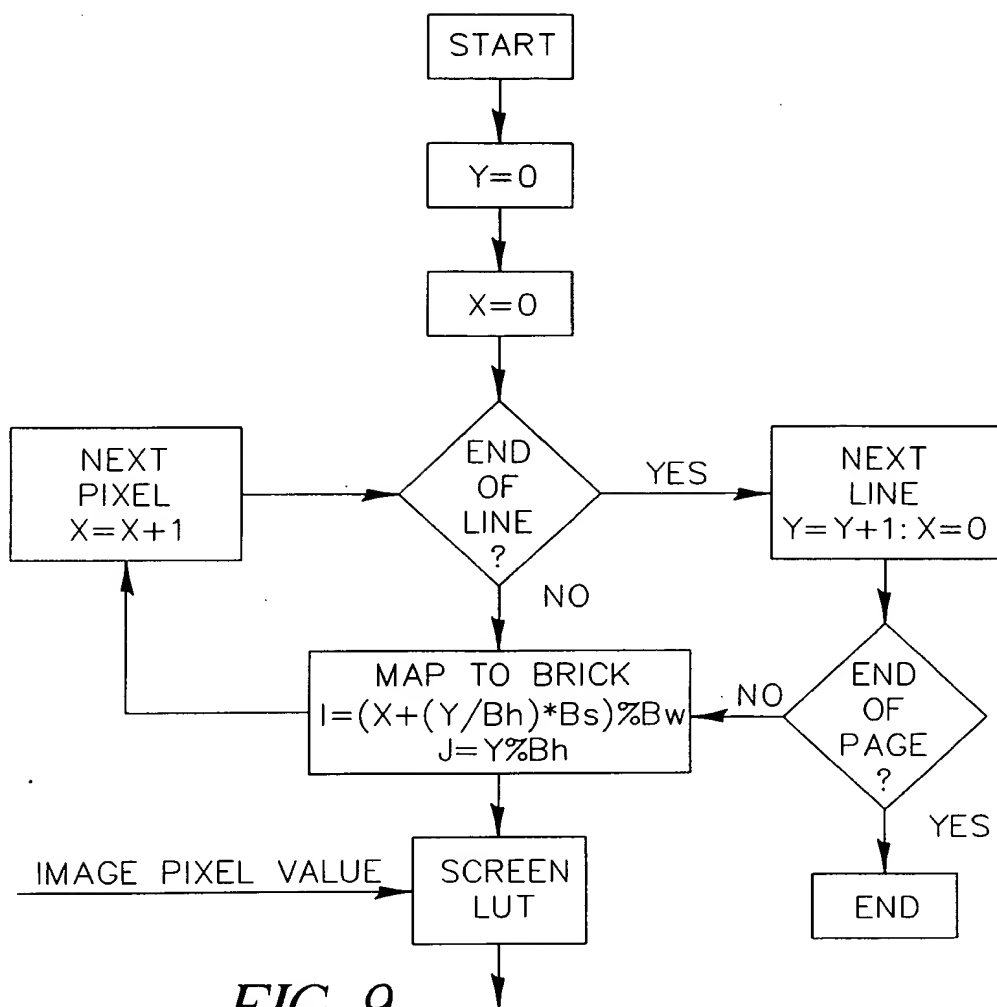


FIG. 9

PLANE 255

255	255
255	255

PLANE 128

127	128
128	128

PLANE 2

1	2
2	2

FIG. 10

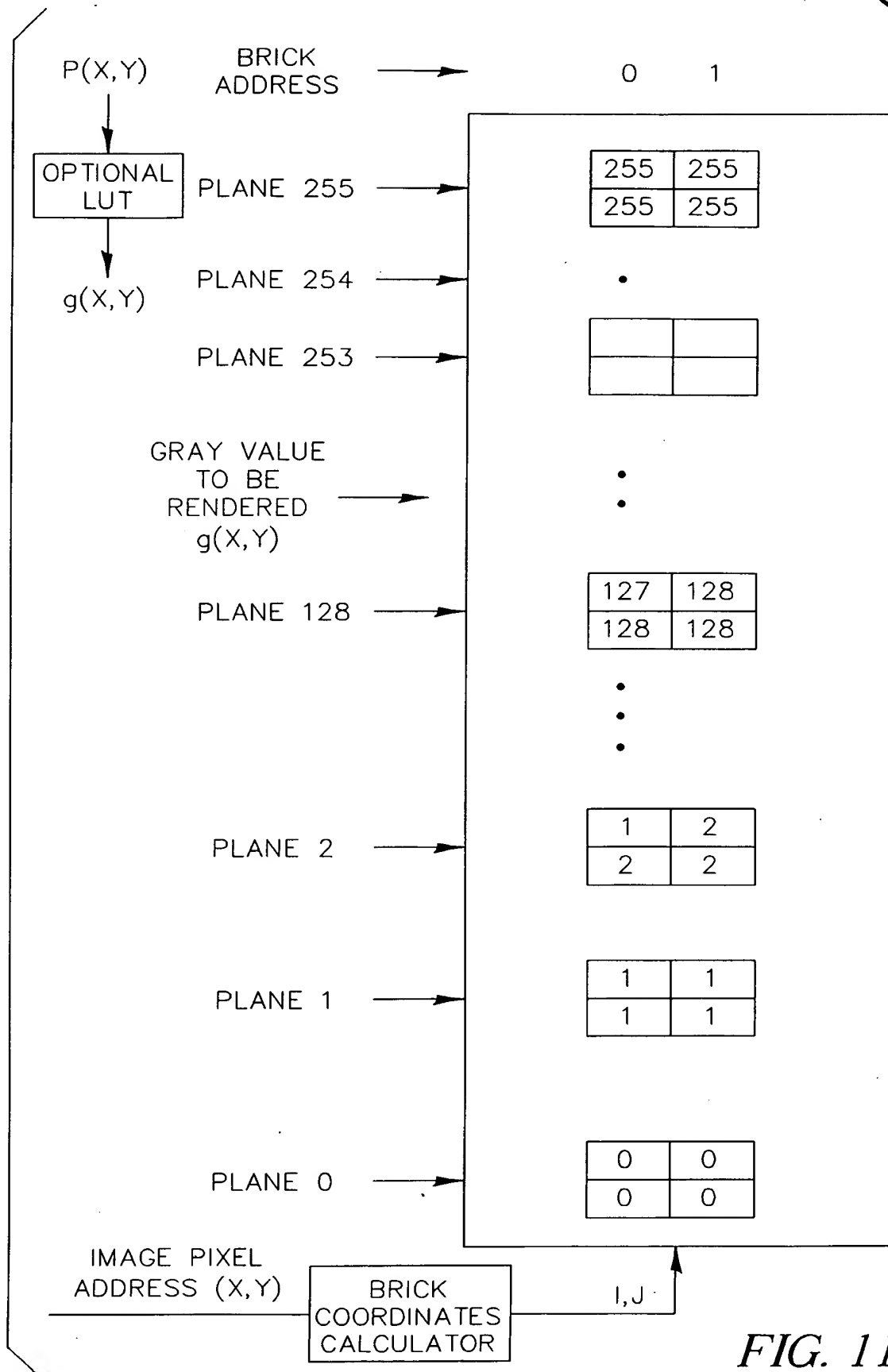


FIG. 11

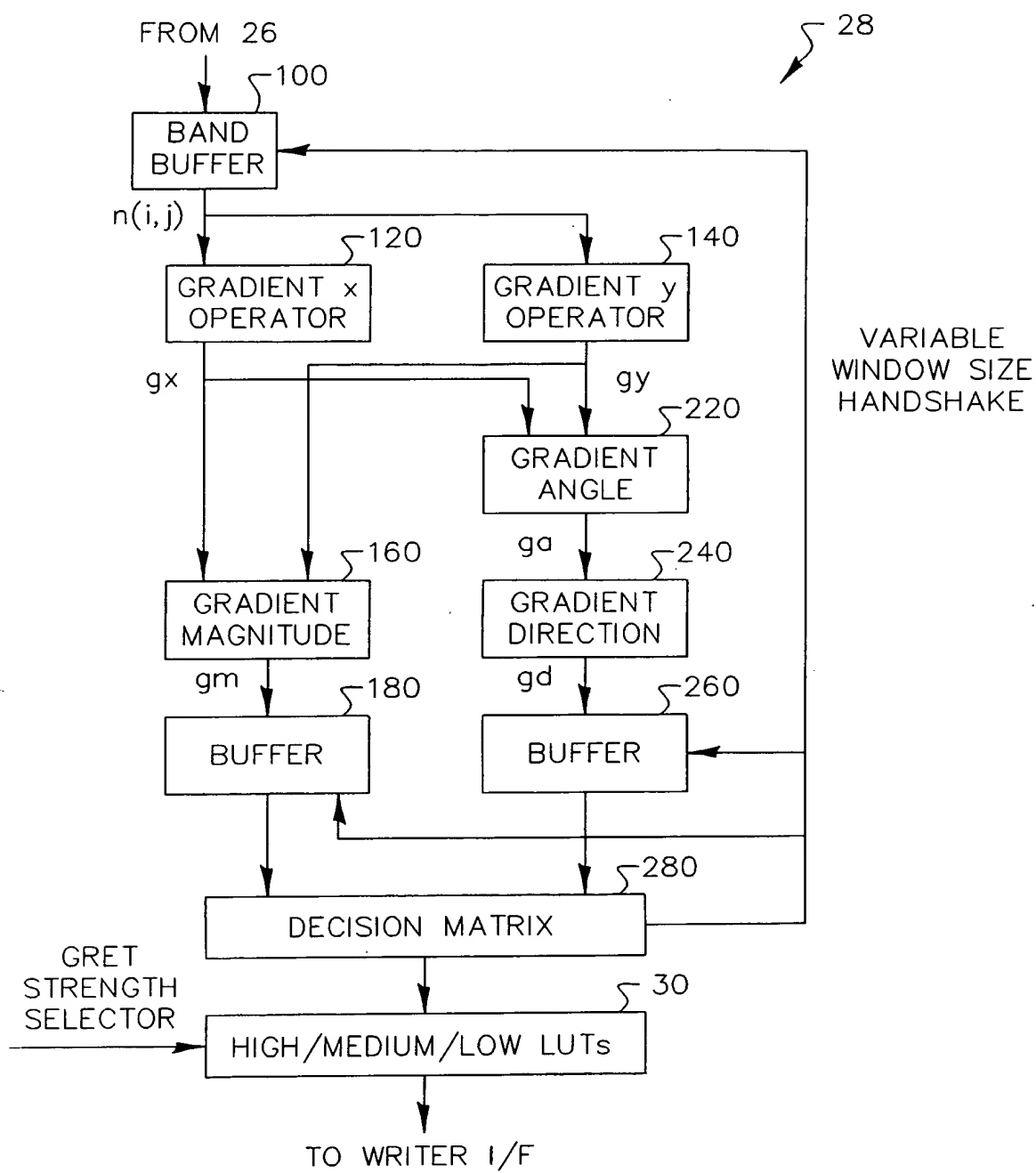


FIG. 12

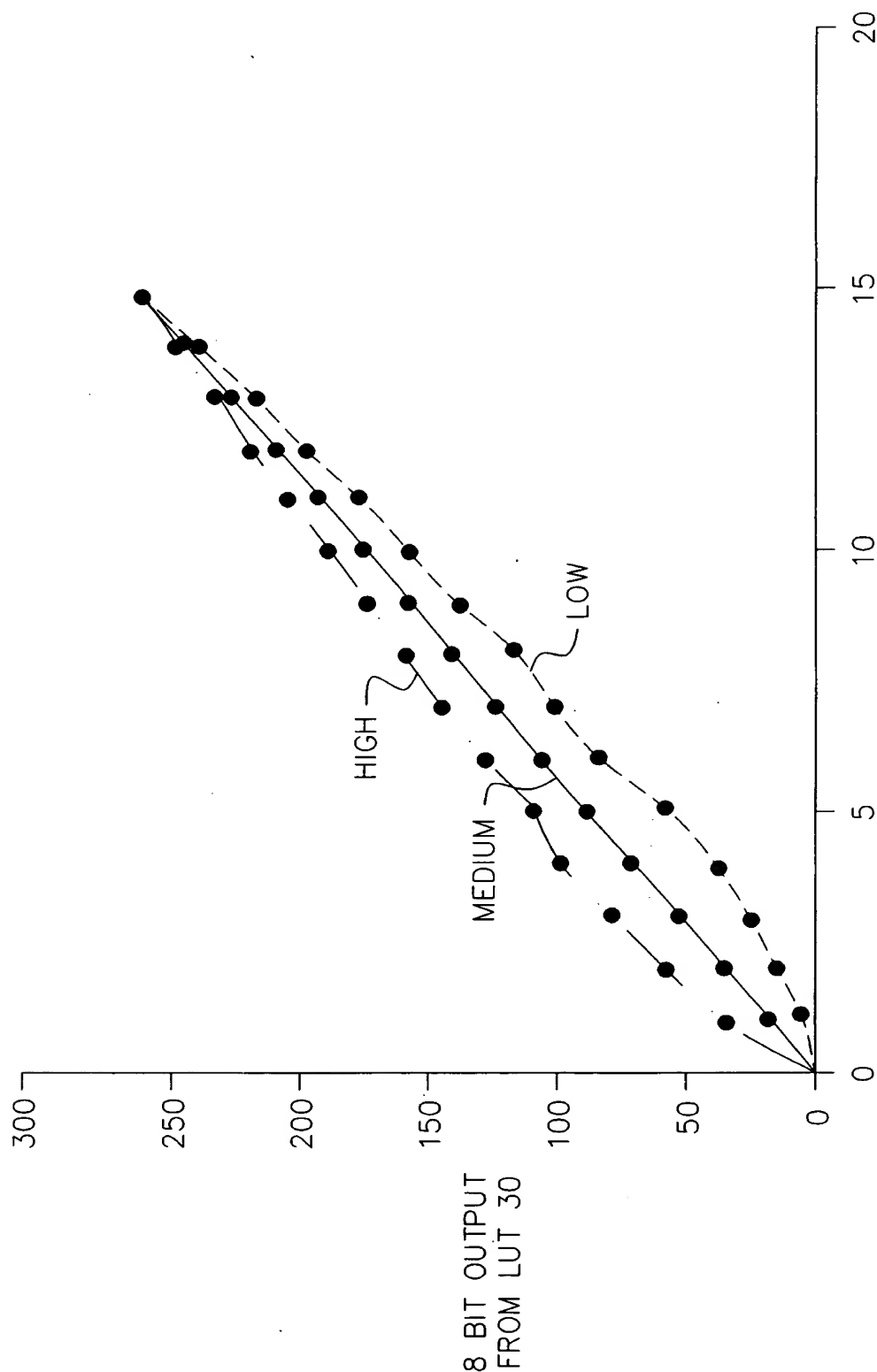


FIG. 13

[illegible]

FIG. 14

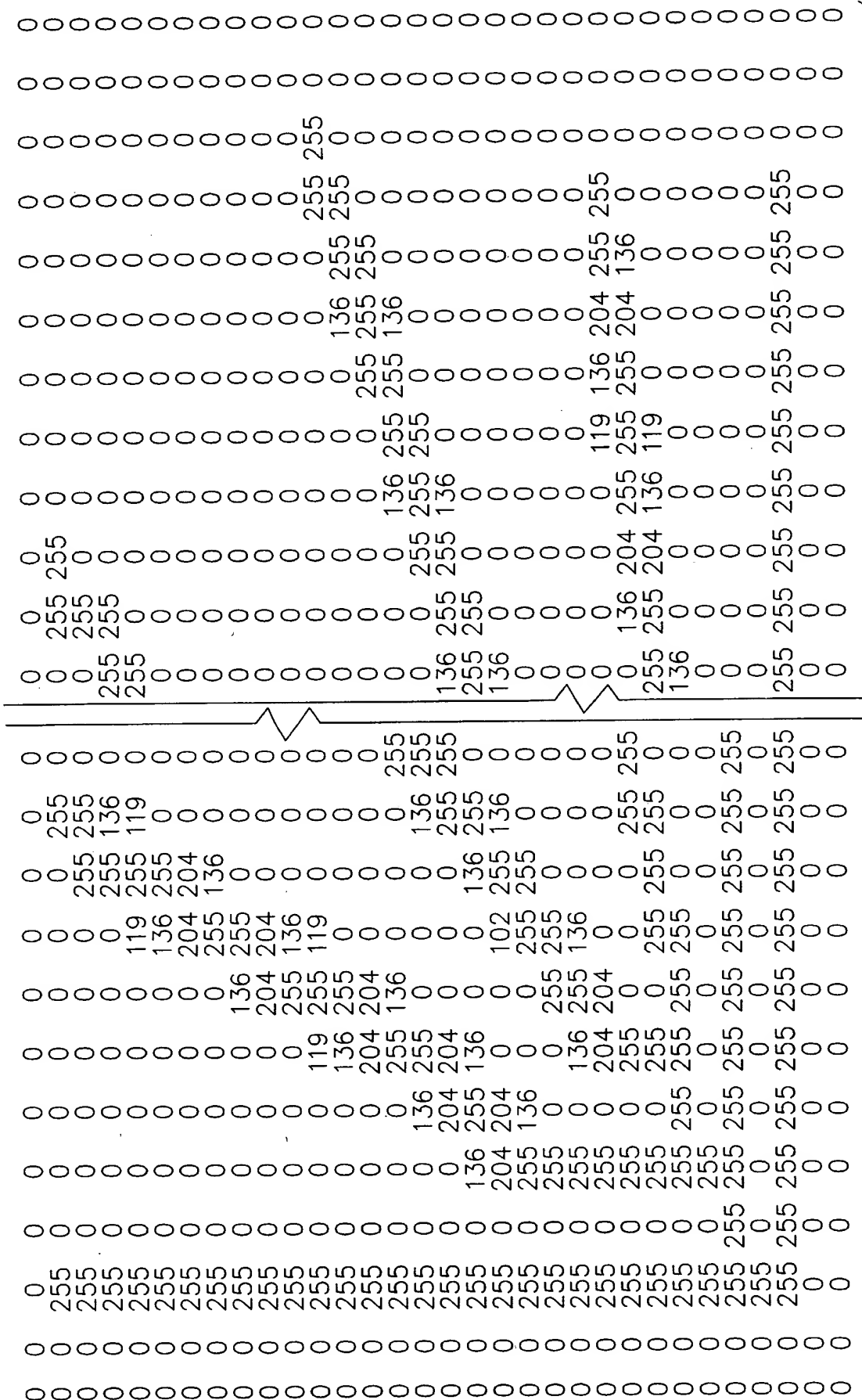


FIG. 15

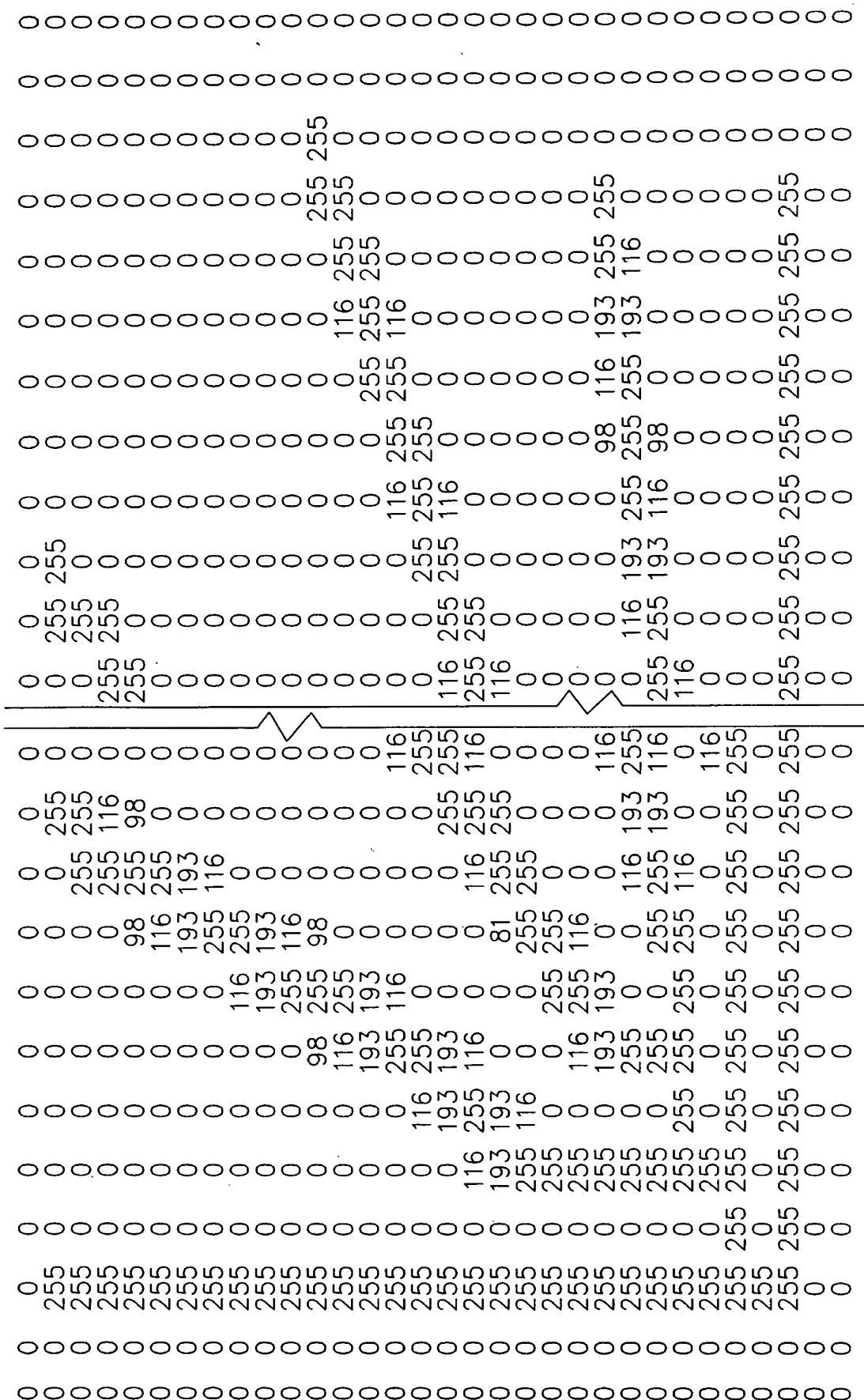


FIG. 16

[illegible]

FIG. 17

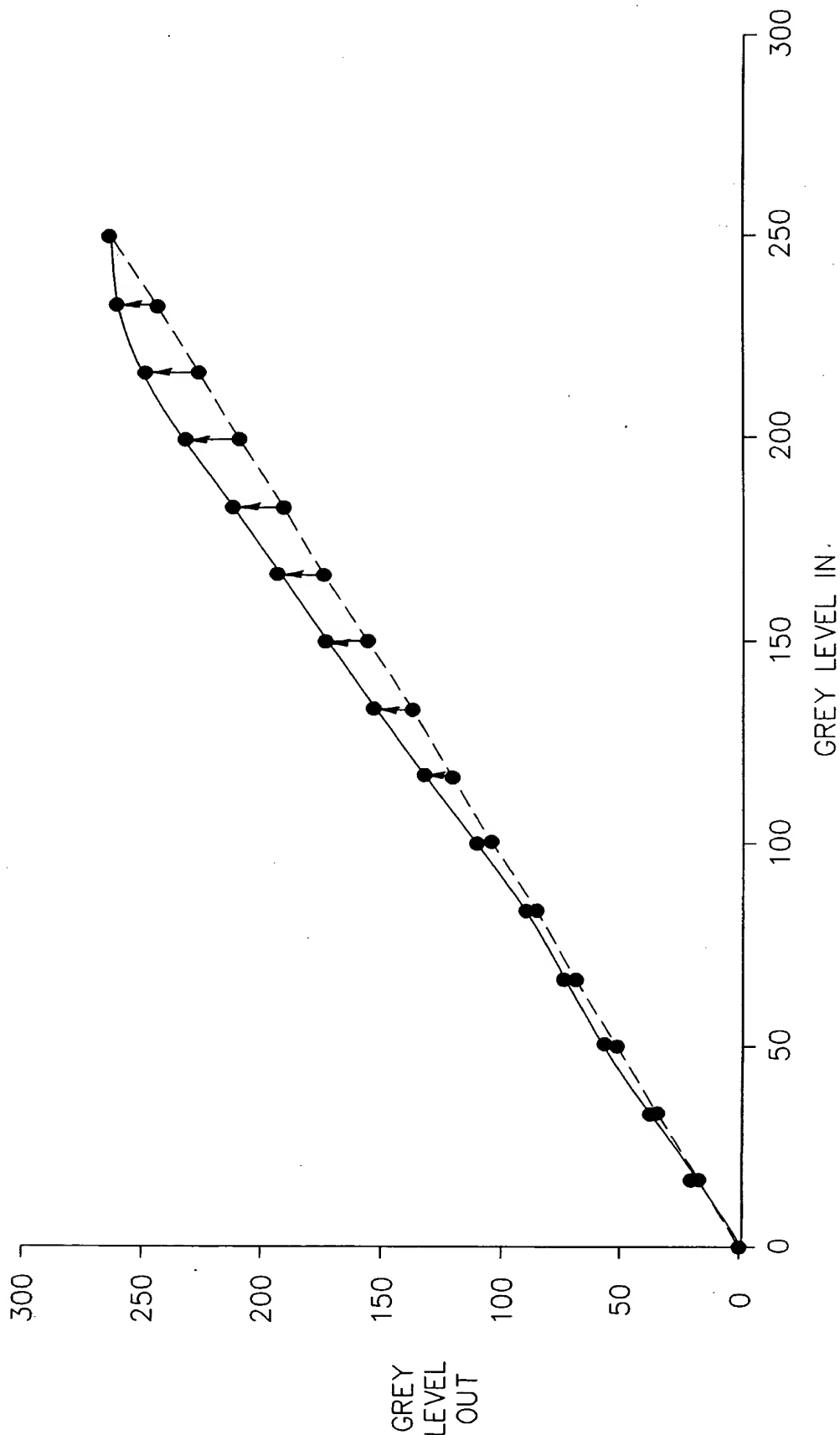
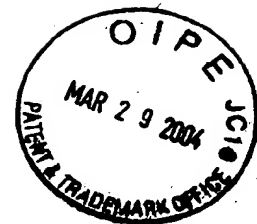
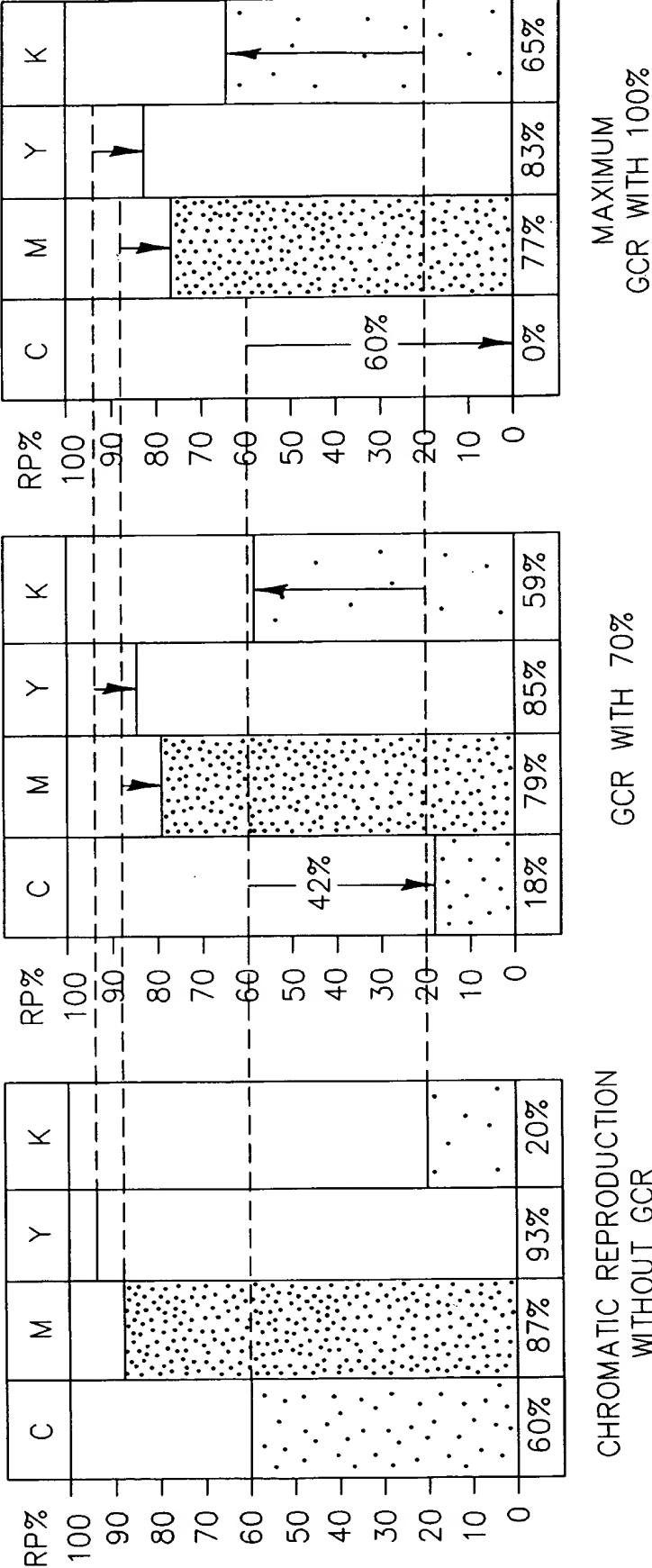


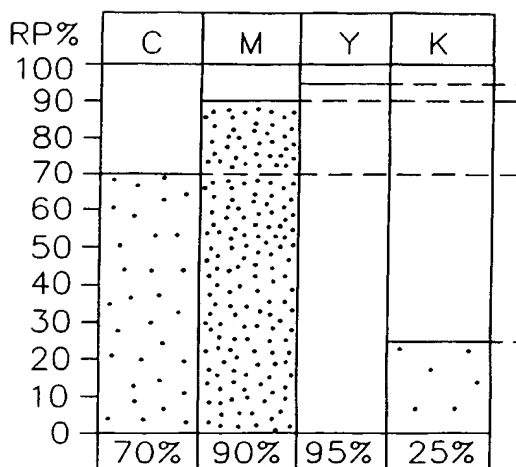
FIG. 18



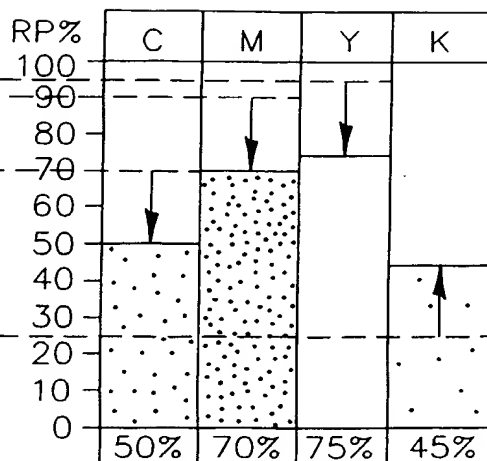


DOMINANT COLORS: Y,M=RED
COMPLEMENTARY COLOR=CYAN

FIG. 20a



CHROMATIC REPRODUCTION
 WITHOUT UCR
 TOTAL DOT AREA 280%



CHROMATIC REPRODUCTION
 WITHOUT UCR
 TOTAL DOT AREA 240%

FIG. 20b



STEP 1

TILE STRUCTURE

X	X	X	X	X	X	X
X	X	X	C1	X	X	X
X	X	C1	C1	C1	X	X
X	C1	C1	C1	C1	C1	X
X	C1	C1	C1	C1	C1	X
X	X	C1	C1	C1	X	X
X	X	X	C1	X	X	X
X	X	X	X	X	X	X

FIG. 21-1

STEP 2

LABEL PIXEL SEQUENCE
IN THE TILE

0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	2	3	4	0	0
0	5	6	7	8	9	0
0	10	11	12	13	14	0
0	0	15	16	17	0	0
0	0	0	18	0	0	0
0	0	0	0	0	0	0

FIG. 21-2



STEP 3

FILL UP IMAGE PLANE WITH TILE

1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16
18	5	6	7	8	9	18	5	6	7	8	9	18
1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16
18	5	6	7	8	9	18	5	6	7	8	9	18
1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16
18	5	6	7	8	9	18	5	6	7	8	9	18
1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16

FIG. 21-3



STEP 4

FOUND REPEATING RECTANGLE
 BLOCKS IN THE IMAGE PLANE

1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16
18	5	6	7	8	9	18	5	6	7	8	9	18
1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16
18	5	6	7	8	9	18	5	6	7	8	9	18
1	10	11	12	13	14	1	10	11	12	13	14	1
3	4	15	16	17	2	3	4	15	16	17	2	3
7	8	9	18	5	6	7	8	9	18	5	6	7
12	13	14	1	10	11	12	13	14	1	10	11	12
16	17	2	3	4	15	16	17	2	3	4	15	16

FIG. 21-4

STEP 5

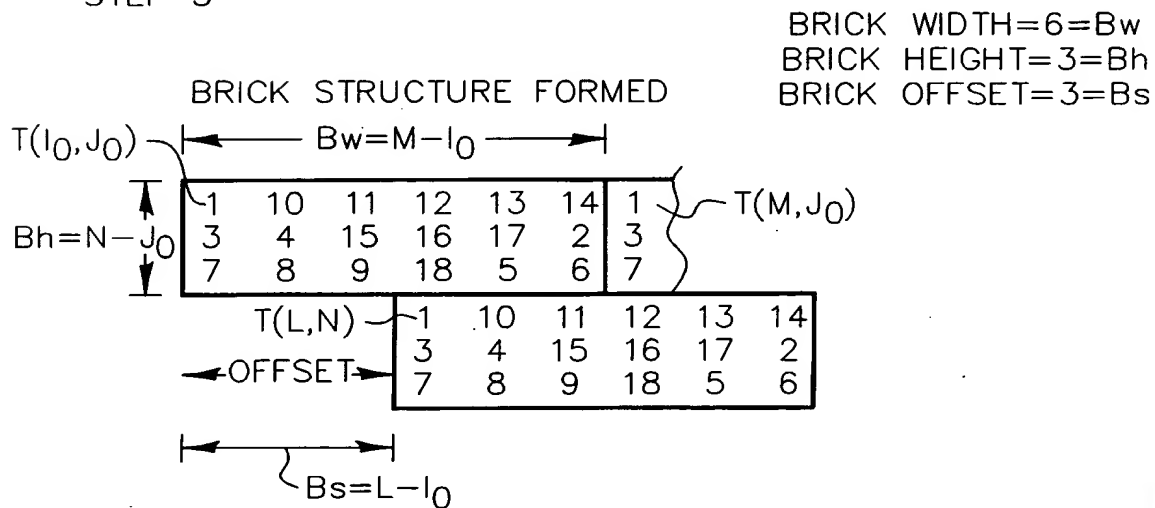


FIG. 21-5



STEP 6

CONVERTS 3-D LUT
TILE STRUCTURE TO
3-D LUT BRICK
STRUCTURE

LEVEL 0

LEVEL 2

106	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

LEVEL 128

255	231	0	0	0	231
255	231	0	0	0	231
220	99	99	220	100	100

LEVEL 255

255	255	255	255	255	255
255	255	255	255	255	255
255	255	255	255	255	255

FIG. 21-6

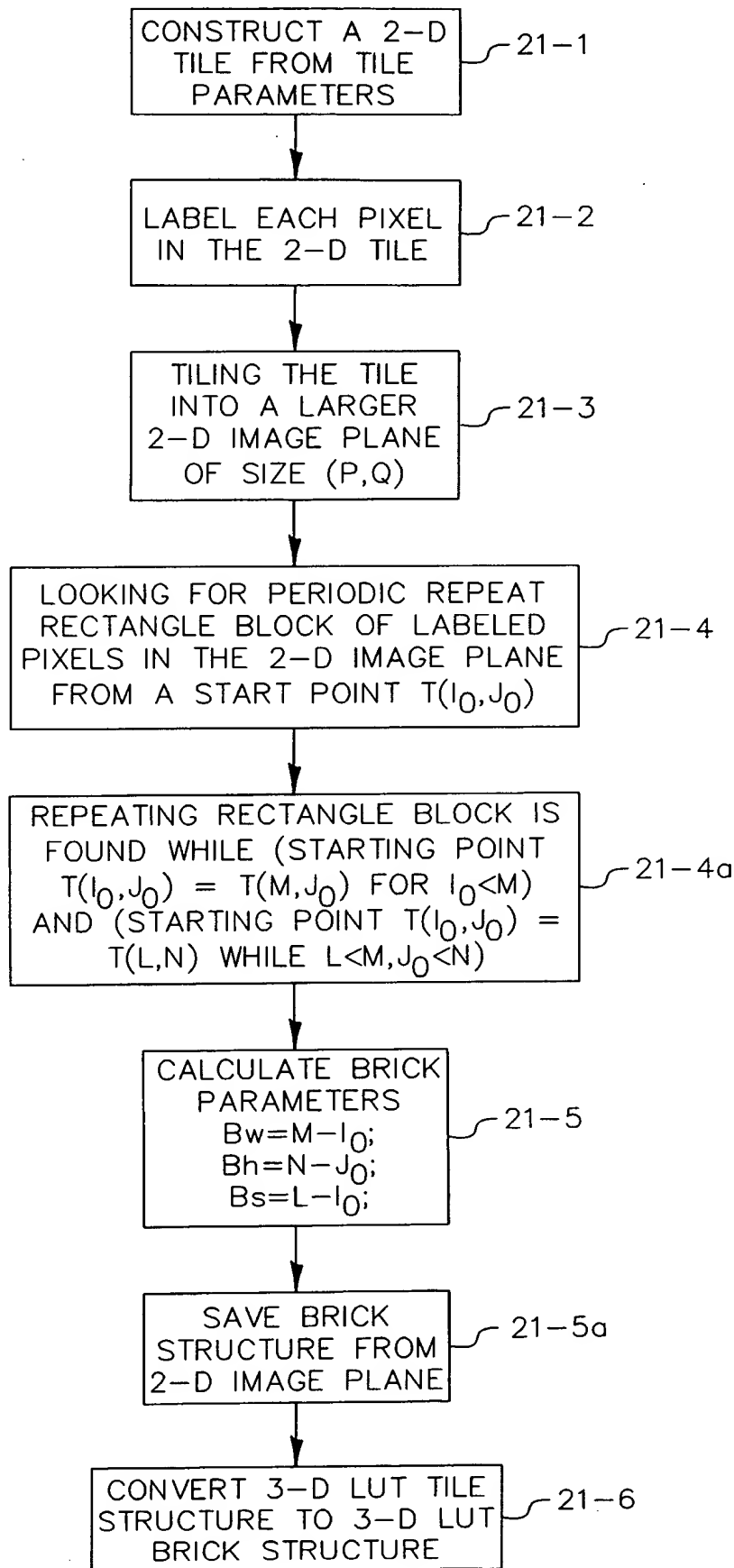
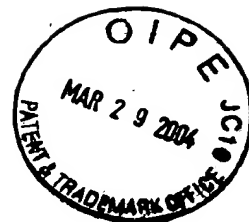


FIG. 22



GRAY LEVEL = 2

C1	C1	C1	C1	C2	C2	C2
C1	C1	C1	C1	C2	C2	C2
C1	C1	C1	C1	C2	C2	C2
C3	C3	C3	C4	C2	C2	C2
C3	C3	C3	C4	C4	C4	C4
C3	C3	C3	C4	C4	C4	C4
C3	C3	C3	C4	C4	C4	C4

S1	E1	S1	E1
S2	E2	S2	E2
S3	E3	S3	E3
S4	E4	S4	E4
S5	E5	S5	E5
S6	E6	S6	E6
S7	E7	S7	E7
S1	E1	S1	E1
S2	E2	S2	E2
S3	E3	S3	E3
S4	E4	S4	E4
S5	E5	S5	E5
S6	E6	S6	E6
S7	E7	S7	E7

FIG. 23a



GRAY LEVEL = 2

0	0	0	0	0	0	0
0	31	18	0	7	42	0
0	15	8	0	3	20	0
0	0	0	0	0	0	0
0	8	5	0	2	11	0
0	38	21	0	8	51	0
0	0	0	0	0	0	0

BRICK STRUCTURE

0	0	0	0	0	0	0
0	31	18	0	7	42	0
0	15	8	0	3	20	0
0	0	0	0	0	0	0
0	8	5	0	2	11	0
0	38	21	0	8	51	0
0	0	0	0	0	0	0

FIG. 23b



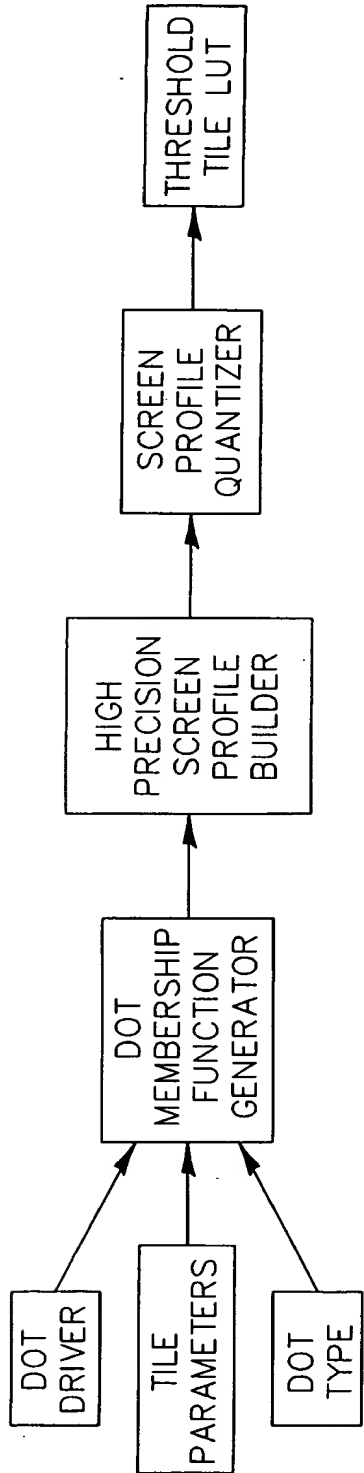
GRAY LEVEL = 128

20	164	83	5	83	164	20
164	255	229	132	223	255	164
83	229	163	51	159	233	83
5	132	51	0	51	132	5
83	223	159	51	158	224	83
164	255	233	132	224	255	164
20	164	83	5	83	164	20

BRICK STRUCTURE

20	164	83	5	83	164	20
164	255	229	132	223	255	164
83	229	163	51	159	233	83
5	132	51	0	51	132	5
83	223	159	51	158	224	83
164	255	233	132	224	255	164
20	164	83	5	83	164	20

FIG. 23c



16X16 DOT SIZE DRIVER

256	245	240	224	204	168	136	92	85	129	161	195	219	233	250	255
252	244	232	208	188	160	116	84	73	109	153	181	209	229	241	248
236	228	216	192	176	144	108	80	69	101	137	169	197	213	225	237
217	212	200	180	152	120	100	63	55	93	121	145	177	189	205	221
193	184	172	148	128	58	46	39	35	51	67	125	149	173	185	201
164	156	140	124	66	42	30	22	19	31	43	59	117	141	157	165
132	112	104	96	50	26	14	6	11	15	27	47	97	105	113	133
88	76	72	54	34	18	10	4	3	8	23	37	61	77	81	89
90	82	78	62	38	24	7	2	1	12	17	33	53	70	74	87
134	114	106	98	48	28	16	9	5	13	25	49	95	103	111	131
166	158	142	118	60	44	32	20	21	29	41	65	123	139	155	163
202	186	174	150	126	68	52	36	40	45	57	127	147	171	183	194
222	206	190	178	146	122	94	56	64	99	119	151	179	199	211	218
238	226	214	198	170	138	102	71	79	107	143	175	191	215	227	235
246	242	230	210	182	154	110	75	83	115	159	187	207	231	243	251
254	249	234	220	196	162	130	86	91	135	167	203	223	239	247	253

FIG. 24

